ENERGY STAR Criteria for Solid State Lighting

Atlanta, Georgia

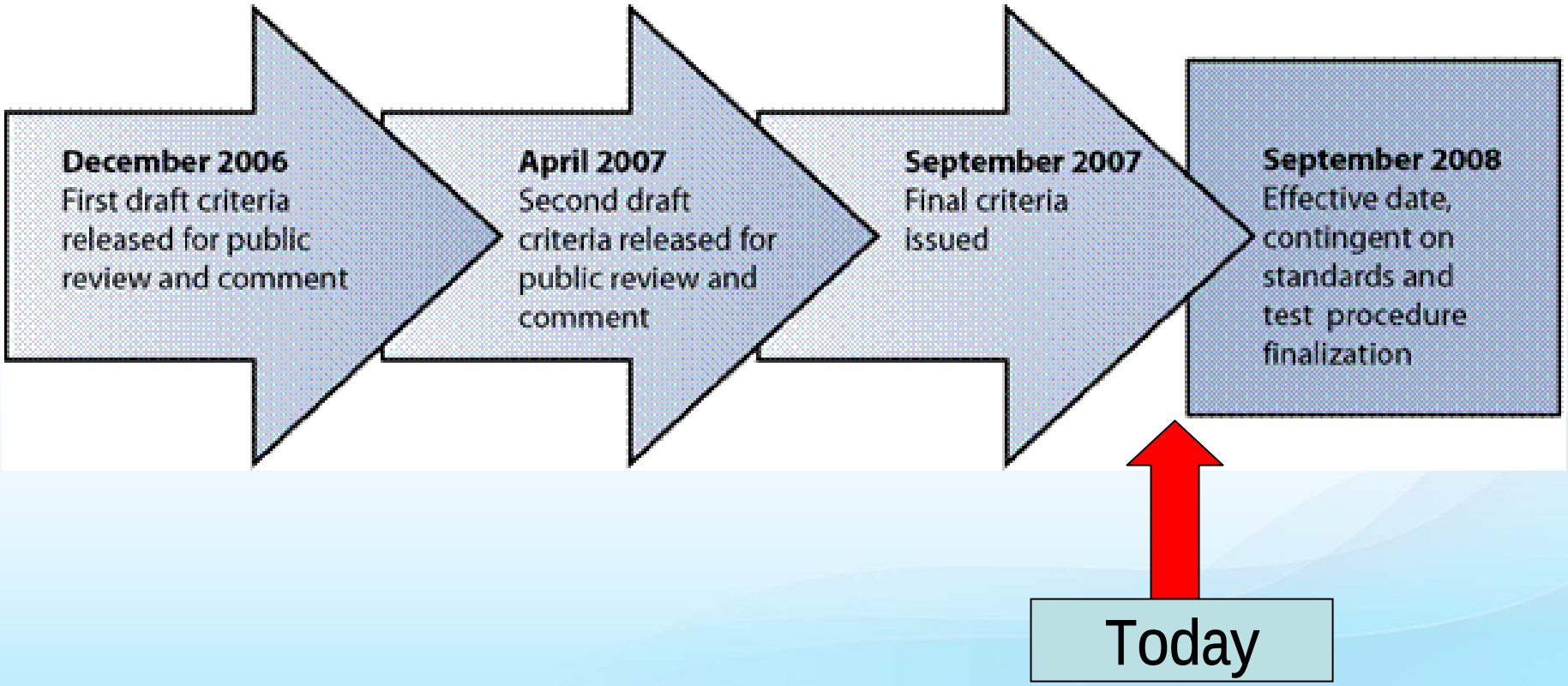
January 30, 2008

Richard Karney

U.S. Department of Energy

Where are we now?

ENERGY STAR CRITERIA TIME LINE



Scope of ENERGY STAR Criteria

- Limits coverage to LED systems for general illumination only
- Both commercial and residential
- Establish 2-category specification:
  - Category A: prescriptive specifications for niche category lighting applications (near-term)
  - Category B: performance specification for all applications (long-term)
- Luminaire efficacy key metric

Transitional Two-Category Approach

- Approach recognizes rapidly changing technology
- Allows early participation of limited range of SSL products for directional lighting applications (Category A)
- In about 3 years, Category A will be dropped entirely; Category B then becomes basis of criteria

Lighting industry is learning the unique issues of applying SSL to general illumination. Going slow allows industry and DOE to learn, and adjust

Efficacy terminology

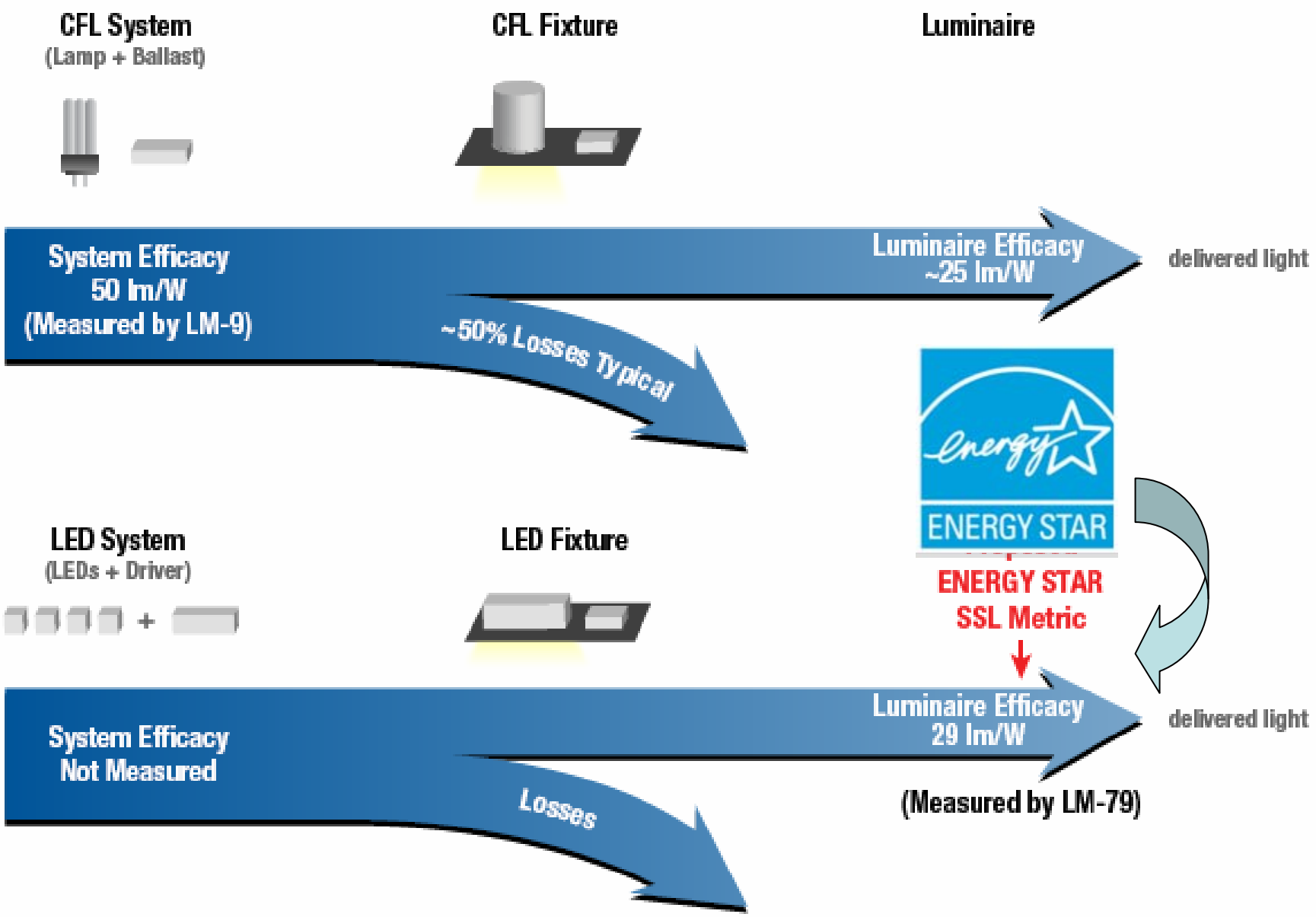
$$\text{Lamp Efficacy} = \frac{\text{Rated Lamp Lumens}}{\text{Lamp Input Power}}$$

$$\text{System Efficacy}_{\text{fluor}} = \frac{\text{Rated Lamp Lumens x BF}}{\text{Ballast Input Power}}$$

$$\text{Luminaire Efficacy} = \frac{\text{Luminaire Light Output}}{\text{Driver Input Power}}$$

System Efficacy Vs. Luminaire Efficacy

(Recessed Downlights Example)



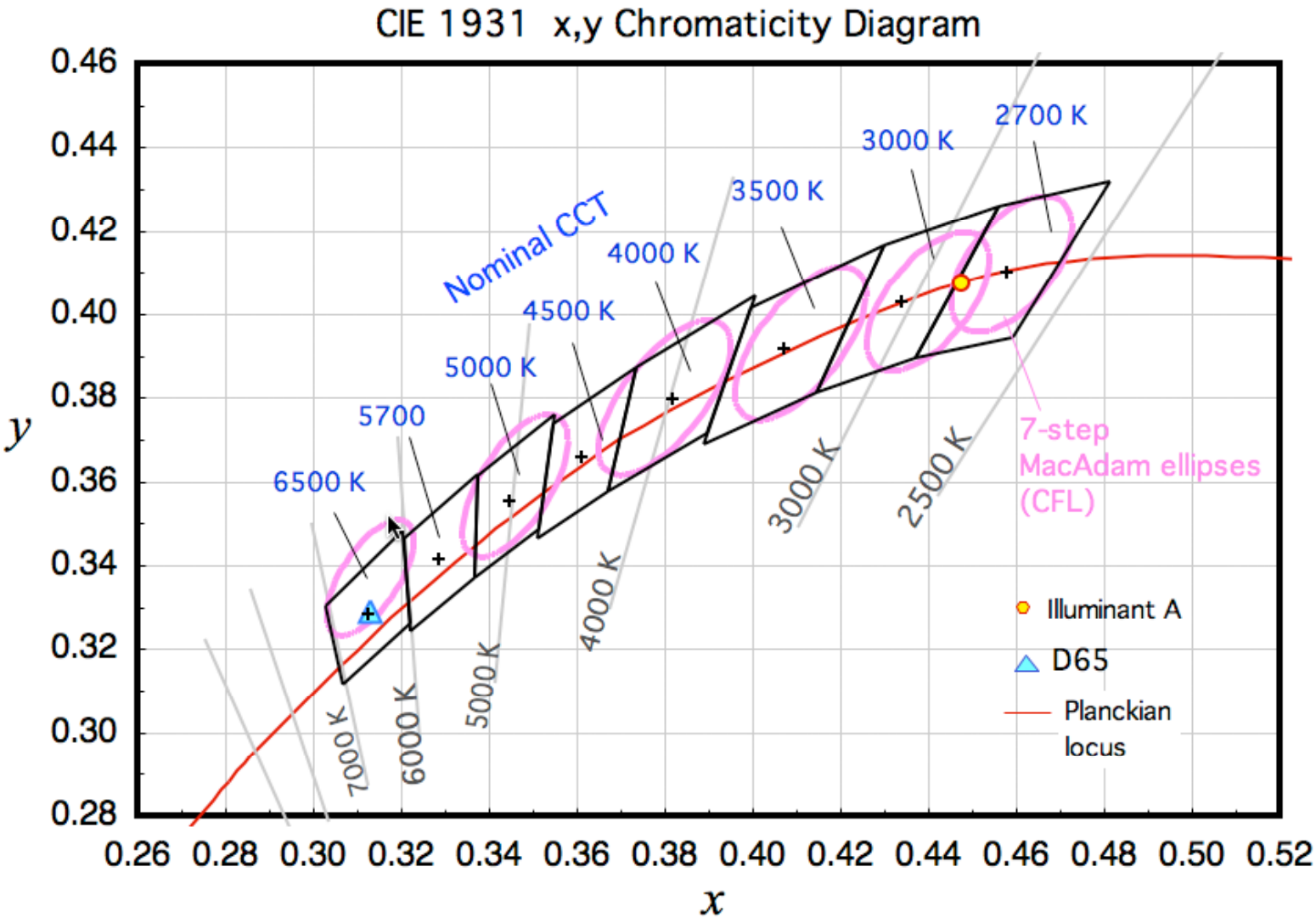
Overall Requirements

- Luminaire
  - CCTs: 8 nominal CCTs
  - Color Spatial Uniformity: 4-step
  - Color Maintenance: 7-step
  - CRI: ≥ 75 for indoor, silent for outdoor
  - Off-state Power prohibited
    - Exception for integral controls, limited to 0.5W
  - 3 Year Warranty
  - Thermal Management

Overall Requirements (cont.)

- Modules/Arrays
  - Lumen depreciation (L_{70})
    - Residential Indoor ≥ 25,000 hours
    - Residential Outdoor and all Commercial ≥ 35,000 hours
- Residential Outdoor Luminaires
  - Attached to buildings and > 13 watts requires photo-control
- Power Supplies
  - Power Factor
    - ≥ 0.7 Residential≥ 0.9 Commercial
  - ≥ 120 Hz Output Operating Frequency
- Packaging Requirements

Chromaticity Diagram



Warranty

- Minimum of 3 years
- Covers repair or replacement of defective electrical parts including light source and power supplies
- Residential products must include a written warranty in the packaging.

Thermal management

- For *in situ* thermal management, manufacturers must adhere to
  - device manufacturer guidelines
  - certification programs
  - test procedures

Lumen Depreciation of LED Light Sources (L_{70})

- LED Module – a component part of an LED light source that may include electrical, optical or mechanical components but does not include a power supply
- LED Array – an assembly of LED packages on a printed circuit board or substrate but does not include a power supply
- LED module(s)/array(s) shall deliver at least 70% of lumens *in situ* for:
  - 25,000 hours for residential indoor products
  - 35,000 hours for residential outdoor products
  - 35,000 hours for all commercial products

Outdoor Luminaire requirements

- Residential luminaires designed to attach to buildings
- If power consumption is greater than 13 watts the luminaire must contain an integral photo-sensor that prevents operation during daylight hours

Power Supply Requirements

- Cannot exceed the manufacturer maximum recommended case temperature when measured during in-situ operation.

Packaging Requirements

- Included documentation must clearly state any known incompatibility with:
  1. photo-controls
  2. dimmers
  3. timing devices

Category A

- Establish minimum luminaire efficacy
  - Benchmark to fluorescent
    - Consistent with current ENERGY STAR lighting criteria
- Directed light applications
  - Energy efficiency potential due to directional light source
  - minimize fixtures losses
- Category A will expand to include other niche products.

Category A: Niche Applications

1. Under-cabinet Kitchen

Category A: Niche Applications

2. Under-cabinet Shelf-mounted Task

Osram

Philips SSL Solutions

Category A: Niche Applications

3. Portable Desk/Task

Category A: Niche Applications

4. Recessed Downlights (Res./Com.)

Renaissance

Progress

Prescolite

Category A: Niche Applications

5. Outdoor Wall-mounted Porch

Category A: Niche Applications

6. Outdoor Step

Category A: Niche Applications

7. Outdoor Pathway

Category B: Efficacy Based Performance

- Aggressive efficacy requirement: 70 lm/W
- Applies to all types of SSL systems for general illumination.
- Allows for non-directional lighting applications
- Manufacturers able to qualify under Category B three (3) years after the effective date
- Between three (3) to five (5) years from now, category A will be dropped.
- Serves as future target for manufacturers

ENERGY STAR Qualification Process

- NVLAP Accreditation Suspension
- Lumen Depreciation
- Product Group Qualification Process
- Product Variations
- Power Supply Qualification
- Online Process for Qualification Submission

NVLAP Accreditation Suspension

- DOE will suspend the NVLAP Accreditation for at least one year from the effective date of the criteria for SSL Luminaires only.
- DOE has initiated an effort to attract more laboratories
- Accept test results only from pre-approved laboratories
- Listing of laboratories will be posted on the ENERGY STAR website.

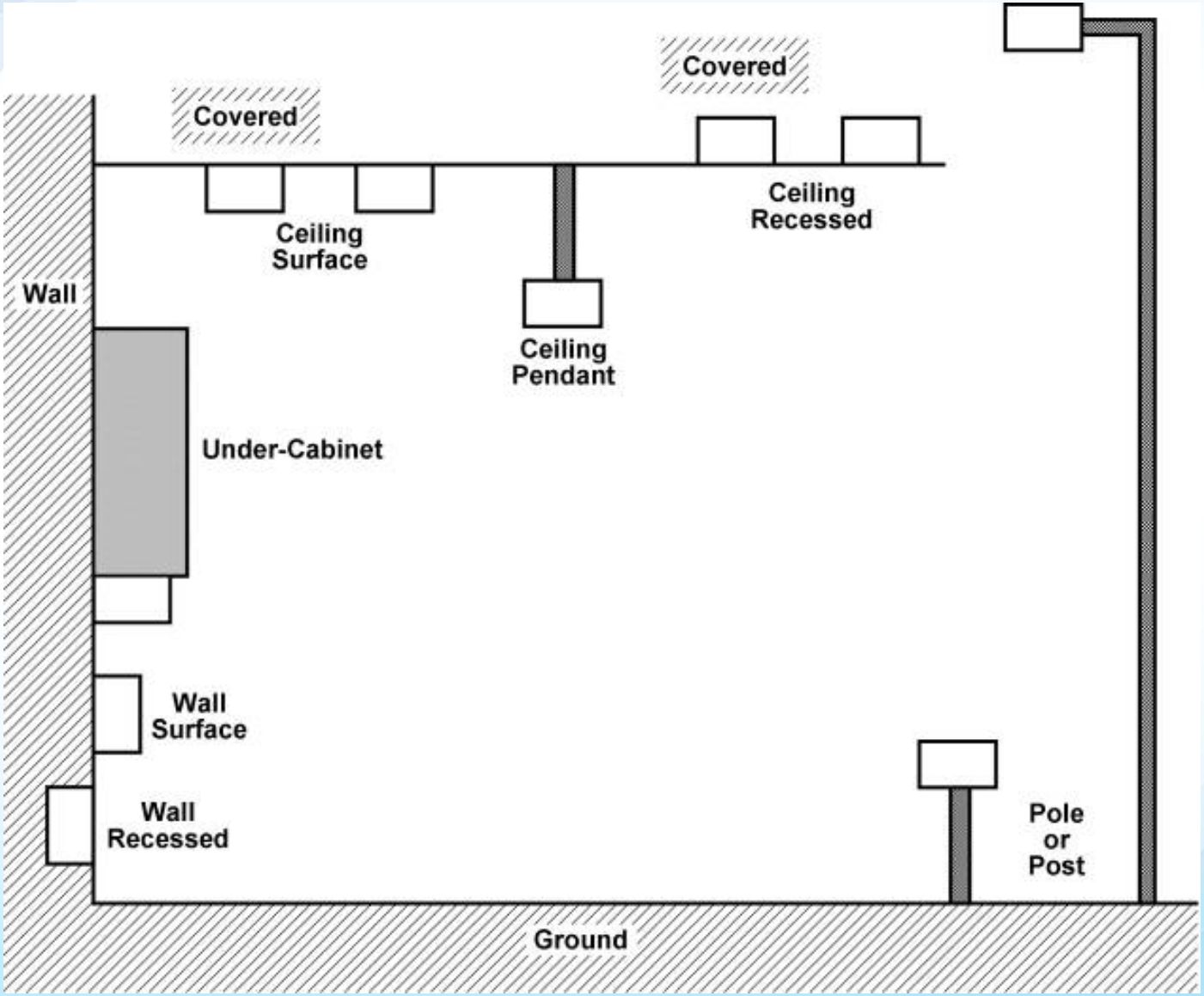
IESNA LM-80

- Lumen maintenance tests will take more than 8 months to complete.
  - 6,000 hour test
  - Measurements taken every 1,000 hours
- Begin testing as soon as possible after test procedure is made public.
- Expected release date in February, 2008.

Lumen Depreciation

- Life determined by in situ temperature measurements of:
  - Module, Array or Light Engine
  - Power Supply/Driver
- Testing may be conducted at the same time as UL 1598.

UL 1598 Environments



Lumen Depreciation Qualification

- Option 1: (Preferred) Component Performance
  - Manufacturer can choose this only if all 3 conditions are met:
    - Module/Array has a current LM-80 test report
    - Module/Array has a designated Temperature Measurement Point (TMP)
    - TMP is accessible for in situ measurement
  - Otherwise manufacturer must use Option 2
- Option 2: Luminaire Performance
  - Entire luminaire subjected to LM-80

Temperature Measurement Point (TMP)

- Manufacturer designates TMP that correlates to LM-80 test report or power supply warranty
  - Module/Array
    - Solder Joint T_s
    - Case Temperature T_c
    - Board Temperature T_b
  - Power Supply
    - Case Temperature T_c
    - Could also be T_b for integral Power Supplies

Lumen Depreciation Passing Criteria

A luminaire passes the L_{70} threshold (≥ 25,000 hours for indoor residential and ≥ 35,000 for all others) if both…

- the in situ measured drive current

AND

- the in situ measured TMP for the module/array

….is the same or lower than the LM-80 test report provided for the module/array.

Product Group Qualification Process

- Applicant defines a grouping of similar products and variations.
- DOE will require and verify that all members of this grouping are identical except for minor variations.
- Applicants will provide a single luminaire representing this product family.
- If it passes, all the members of the proposed grouping receive the ENERGY STAR qualification.

Product Variations

Variations Within Product Groupings	
Housing/Chassis	not allowed
Heat Sink/Heat Management	not allowed
Finish	allowed
Reflector/Trim	allowed
Shade/Diffuser	allowed
Mounting	allowed
Light Source	allowed, w/ conditions
Power Supply	allowed, w/ conditions

Power Supply Qualification

- Power supply that is integral with the module/array or enclosed within the fixture must undergo in situ testing.
- Power supply case temperature or TMP shall be measured under steady-state conditions
- Passes if the case temperature or TMP is less than or equal to the warranted temperature specified by the power supply manufacturer

Online Process for Application Submission

- Qualification Applications
  - Will be submitted on-line by manufacturers
- Test Lab Results
  - Upload test reports to Web site

Quality Assurance (QA)

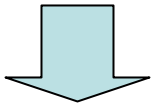
- ENERGY STAR is synonymous with quality
- QA Testing will ensure products meet or exceed customer expectations
- Manufacturers required to participate
- Non-compliance terms

Quality Assurance Testing

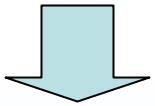
- Testing lab will procure three (3) samples through the marketplace
- Test for
  - Total Luminous Flux
  - Luminaire Efficacy
  - Correlated Color Temperature
  - Color Rendering Index
  - Steady State Module/Array Temperature
  - Maximum Power Supply case/TMP Temperature

Results of Non-compliance

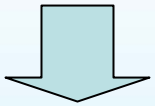
- One product failure in a grouping will disqualify the entire group



- Two product failures in a grouping will place the applicant on a probationary list.

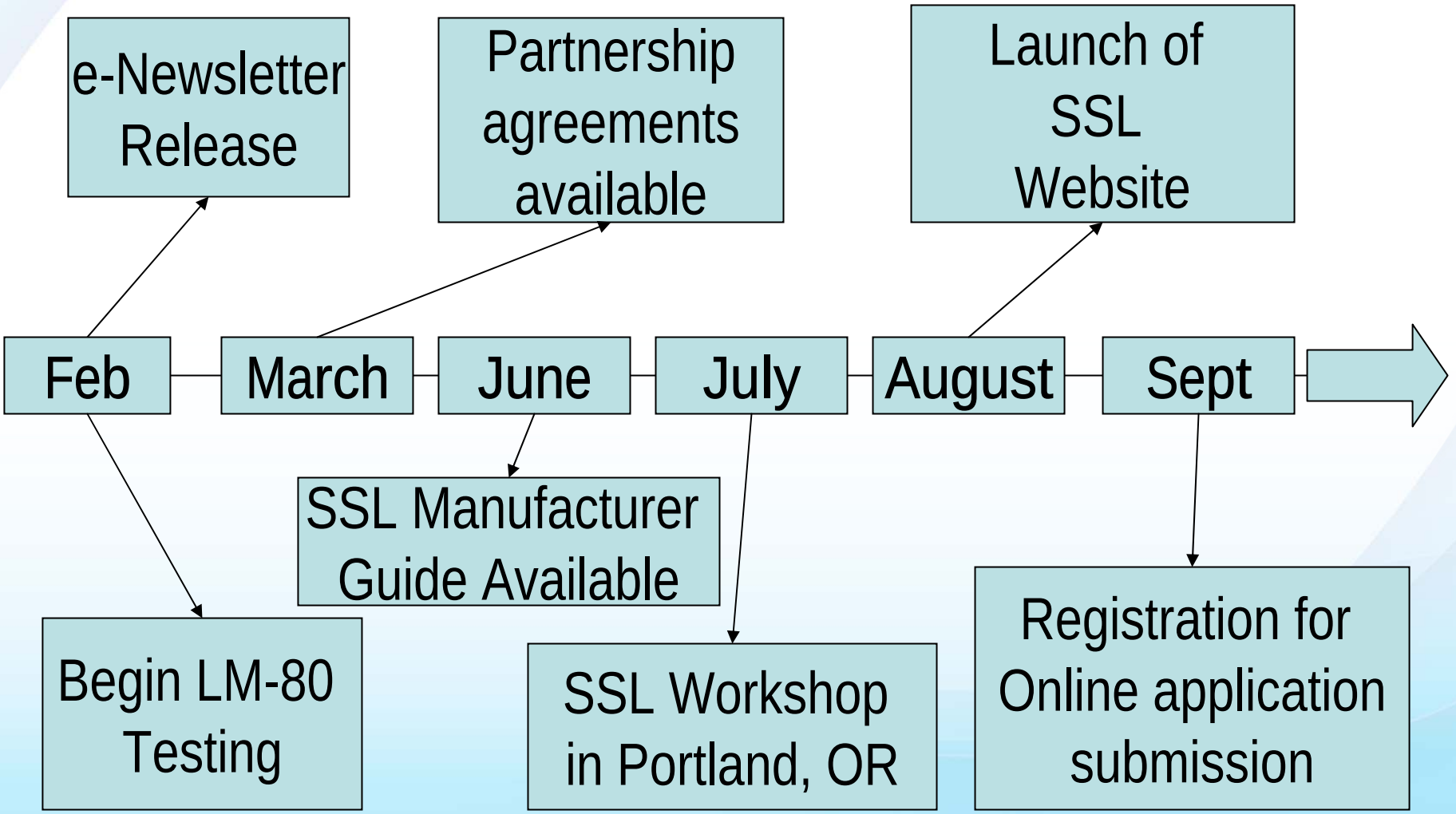


- Probation suspends applicant's ability to use groupings and have to qualify each unique product separately.



- Applicant is removed from probation after one year.

Manufacturer's Timeline, February – September 2008



Partner Recruitment and Support

- ENERGY STAR announcements through industry trade journals, magazines, and relevant websites and list-serves
- Produce a monthly E-newsletter and provide email announcements to keep partners updated on ENERGY STAR
- Provide partner support for qualification process.
- Develop FAQs and brochures

Tools and Resources

With all of the marketing activity focused on SSL, the Department is focused on providing comprehensive and engaging information to customers and partners.

- Partner Resource Guide
- Info graphics
- SSL Facts & Figures
- Frequently Asked Questions (FAQs)
- Mini Business Case
- Product Profiles, Market Profiles, Product Snapshots
- Media Outreach and support
- Sales Data

Questions?

Richard Karney

U.S. Department of Energy

Richard.Karney@ee.doe.gov

http://www.netl.doe.gov/ssl/